

Nuclear Energy University Program (NEUP) Fiscal Year (FY) 20 Annual Planning Webinar

RC-2 Micro-reactor Technology Development and Support for Deployment

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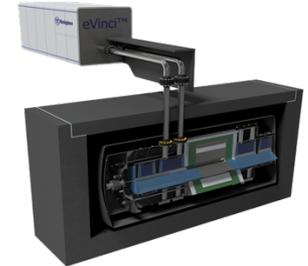
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Micro-Reactor Benefits and Applications

DOE believes micro-reactors have the potential to provide the commercial and defense sectors with a clean, reliable, and resilient energy supply technology

Potential benefits include:

- Enhanced inherent safety characteristics
- Semi-autonomous and remote control operations reducing staffing needs
- High temperature operation for both electricity and process heat production
- Highly integrated and transportable systems reducing on-site construction times



Potential applications include:

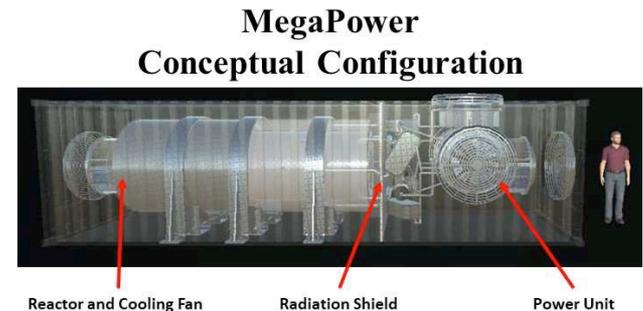
- Competitive electricity and process heat supplies for remote and off-grid communities and industrial locations
- Resilient and reliable energy supplies for remote and forward military bases
- Reliable and clean electricity supplies for disaster and emergency relief operations

Program Mission and Objectives

Mission: Enable micro-reactor technology demonstration at a DOE National Laboratory and subsequent deployment for commercial and/or defense applications

Objectives:

- Identify technology research and development requirements for micro-reactor concepts
- Perform laboratory-led, early-stage R&D supporting cross-cutting micro-reactor technology development and licensing activities
- Coordinate with NRC, DoD, and industry to demonstrate micro-reactor technology on a DOE national laboratory site



Major Program R&D Areas

Industry and DoD stakeholder feedback have informed micro-reactor R&D efforts in the following areas:

- Accelerating micro-reactor HALEU production and fuel fabrication capabilities
- Preparing potential national laboratory micro-reactor demonstration sites
- High fidelity, dynamic analysis of conceptual designs
- Demonstrating innovative cross-cutting micro-reactor technologies such as heat pipes and advanced moderators
- Qualifying advanced high temperature materials and exploring additive manufacturing techniques
- Developing remote monitoring and semi-autonomous control systems
- Assessing potential DOE, DoD, and NRC regulatory pathways for both near-term micro-reactor demonstration and future “nth of a kind” commercial applications

RC-2.1 Micro-Reactor Deployment Markets

Seeking proposals to analyze potential markets and applications that take advantage of unique micro-reactor characteristics

Example micro-reactor application topics requiring further techno-economic analyses include:

- Requirements and ability to site micro-reactors in both remote and populated areas
- Assessment of micro-reactor needs for remote industries including mining, high value local data processing centers, and other applications unique to micro-reactors
- Evaluation of micro-reactors use for increased resilience of the existing electrical grid and for micro-grids

NOTE: Studies should incorporate current micro-reactor designs and concepts, avoid duplication of recent micro-reactor market studies, recommend micro-reactor design requirements and potential improvements relevant to specific applications, and provide a data-driven market assessment for a range of micro-reactor sizes

RC-2.2 Validation of Micro-Reactor Modeling and Simulation Tools

Seeking proposals to support the validation (via existing experimental data and/or new experiments) of modeling and simulation capabilities being developed by the Nuclear Energy Advanced Modeling and Simulation (NEAMS) program for use in micro-reactor design and licensing activities.

Specific areas for validation include:

- Neutronics validation specifically considering unique micro-reactor materials, such as high-temperature moderators
- Thermal/heat transfer for gas-cooled and heat-pipe-cooled micro-reactors including in-reactor heat transfer and coupling to heat exchangers
- Mechanics of structural systems such as solid-core block
- Integrated system performance validation

NOTE: This work scope specifically is focused on validating NEAMS tools and maturing them for micro-reactor deployment applications (i.e., not on development of new modeling and simulation capabilities). Experimental work to develop validation data for current design concepts is encouraged. Proposals should connect the proposed experiments with a clear validation need.

RC-2.3 Micro-Reactor Technology Development and Maturation

Seeking proposals to develop deployment approaches for innovative technologies and solutions specific to micro-reactors. These technologies and solutions should build upon and enhance (though not duplicate) previous/existing DOE advanced reactor technology RD&D efforts

Example areas include:

- Reducing the amount of high-assay low-enriched uranium (HALEU) required for micro-reactor concepts
- Accelerating manufacturing and fabrication approaches for unique micro-reactor components
- Flexible siting options that reduce on-site preparation needs and supports site-independent designs
- Transportation of fueled micro-reactors to site and return of the used micro-reactor
- Micro-reactor operational and maintenance regimes that minimize staffing requirements
- Integration of micro-reactor components such as innovative heat exchangers (heat pipe, gas, and/or liquid coolants) to power conversion systems and/or process heat systems

NOTE: Technologies and RD&D approaches should be described in detail and include a description of the expected improvements over the current state of the art and improvements in development schedule and cost. The technology readiness and development time line should also be described in detail.